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Notes on Afrotropical Pyrgodesmidae, 2 (Diplopoda: Polydesmida)

Заметки по афротропическим Pyrgodesmidae, 2 (Diplopoda: Polydesmida)

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КЛЮЧЕВЫЕ СЛОВА: диплопода, Pyrgodesmidae, таксономия, новый вид, новая комбинация, ключ, Камерун.

ABSTRACT. The genera *Urodesmus* and *Monachodesmus* are reviewed and shown to comprise four and 18 species, respectively, all keyed, including *U. cornutus* sp.n., *M. longicaudatus* sp.n. and *M. armorum* sp.n., all three from Cameroon. In addition, the West African genus *Udodesmus* is recorded in Cameroon for the first time, being represented there by *U. camerunensis* sp.n., which is unique among congeners in showing 5+5 undifferentiated lobulations at the anterior margin of the collum.

РЕЗЮМЕ. Даны обзоры родов *Urodesmus* и *Monachodesmus*, которые содержат теперь соответственно четыре и 18 видов. Для них всех составлены кдючи, в т.ч. *U. cornutus* sp.n., *M. longicaudatus* sp.n. и *M. armorum* sp.n. из Камеруна. Кроме того, западноафриканский род *Udodesmus* впервые приводится для фауны Камеруна, где он представлен *U. camerunensis* sp.n., который уникален среди видов рода тем, что у него 5+5 недифференцированных долей на переднем краю коллума.

Introduction

The mainly tropical millipede family Pyrgodesmidae is among the largest, but taxonomically perhaps most confused in the entire class Diplopoda, currently counting almost 400 species or subspecies in 170+ genera, nearly 120 of which are monotypic [Jorgensen, Sierwald, 1910; updated].

The present paper puts on record four new species of Pyrgodesmidae from Cameroon. In this connection, two genera are reviewed and rediagnosed.

Material and methods

Most of the material treated here derives from the collection of the Musée Royal de l'Afrique Centrale (MRAC), Tervuren, Belgium, with only a few duplicates retained for the collection of the University of Yaoundé 1, Cameroon (UYC) or donated to the Zoological Museum, State University of Moscow (ZMUM), Russia. The samples are stored in 70% ethanol. Specimens for scanning electron microscopy (SEM) were air-dried, mounted on aluminium stubs, coated with gold and studied using a JEOL JSM-6480LV scanning electron microscope. Photographs were taken with a Leica digital camera Leica DFC 500 mounted on a Leica MZ16A stereomicroscope. Images were processed with the Leica Application Suite software.

Taxonomic part

On the statuses of *Urodesmus* Porat, 1894 and *Monachodesmus* Silvestri, 1927

Urodesmus was one of the earliest genera of Pyrgodesmidae to have been proposed. Porat [1894] compared it directly with *Pyrgodesmus* Pocock, 1892, and described two species therein: *Urodesmus erinaceus* Porat, 1894 and *U. sexcarinatus* Porat, 1894, both from Cameroon. However, *Urodesmus* was properly typified only by Silvestri [1896] who not only beautifully redescribed *U. erinaceus* from type material [Silvestri, 1927], but also designated it as the type species. Verhoeff [1936] ignored the above typification, as well as a couple of varieties which Silvestri [1927] had distinguished in *U. erinaceus*: *U. e.* var. *nigeriensis*, from Nigeria, and *U. e.* var. *minor*, from Fernando Po Island.

From the very start, *U. erinaceus* was readily distinguished from *U. sexcarinatus* by the presence of a paramedian pair of very high, sometimes vaguely bilobed, basally subcontiguous, anteriorly directed, roundish tubercles located in the central part of the collum behind a nearly straight anterior margin with 5+5 rather superficial lobulations [Porat, 1894; Silvestri, 1927]. Each following metatergite in *U. erinaceus* shows a paramedian pair of similarly high, often heavily earth-encrusted, apically largely vaguely bi- or trilobate, mostly subvertical and clearly separated tubercles growing increasingly strongly inclined caudad only in the last few segments. The paraterga are prominent, set very low, subhorizontal, lying almost level to venter, vaguely bi- or trilobate at the lateral margin, devoid of antero- and caudolateral lobulations. The pore formula is normal (5, 7, 9, 10, 12, 13, 15–19), very evident porosteles are only present in paraterga 5, 7, 9, 10, 12, 13, 15 and 16. The dorsal protuberances of segment 19 are clearly directed caudad, short to moderately elongate, even if clearly split medially, then leaving the tip of the epiproct fully or nearly exposed in dorsal view. The gonopods in *U. erinaceus* are deeply sunken inside a prominent gonocoel, the telopodites are massive, complex, deeply bi- or tripartite, including a solenomere.

Such a concept of *Urodesmus* has since remained largely intact. Only Attems [1940] correctly added *Stylodesmus camerunensis* Silvestri, 1927, from Cameroon, while *Stylodesmus horridus* Cook, 1895, and its further two congeners from western Africa, have been removed [Mauriès, Maurin, 1981; Golovatch, VandenSpiegel, 2014]. As a result, *Urodesmus* currently encompasses only the following few species: *Urodesmus erinaceus* Porat, 1894 (the type species), from Cameroon, Fernando Po Island, and Nigeria, *U. camerunensis* (Silvestri, 1927), from Cameroon, and *U. simplex* Silvestri, 1927, from Nigeria.

Urodesmus serratus Verhoeff, 1936, described from Sri Lanka as the type, and sole constituent, species of the subgenus *Attemsocyphus* Verhoeff, 1936 [Verhoeff, 1936; Attems, 1940], seems best to be removed from *Urodesmus*, albeit largely based on zoogeographical grounds. Here we follow Verhoeff [1937] not only because he promoted *Attemsocyphus* to the rank of a full genus, but he also provided meaningful illustrations of the collum, caudal body end and gonopod structure to further document the differences of *A. serratus* from *Urodesmus* spp. These diffferences also concern the presence of intercalary granulations between the main crests which never occur in the African counterparts.

One new species is added here to *Urodesmus*.

In contrast, the collum in *U. sexcarinatus* shows 2+2 and 2+2 central, rather small tubercles behind an indistinctly 5+5 lobulate anterior margin [Porat, 1894]. In addition, metaterga 2-4 each has two, following ones three, transverse rows of small round tubercles, the dorsal crests being clearly higher than the lateral crests which lie above the paraterga. What seems especially remarkable, however, is the presence of caudad rather strongly elongated, coniform crests 19 which conceal the tip of the epiproct from above.

Such conditions readily remind of those observed in the rather large, mostly Afrotropical genus *Monachodesmus* Silvestri, 1927. The main differences from *Urodesmus* lie in the ornamentation of the collum and following metaterga, these in the latter genus showing 1+1 high dorsal protuberances which are rather weakly split on segment 19 and usually fail to conceal the tip of the epiproct from above (Figs 1A, 2A–I). The distribution patterns of ozopores and tergal ornamentations along the body remain basically the same, only porosteles in *Monachodesmus* are exceptionally absent from segment 16. Each dorsal crest on segments 2–4 is composed of two tubercles, thereafter, like all lateral crests, of three tubercles. The paraterga in *Monachodesmus* species are only seldom poorly developed, nearly wanting, while many species show small intercalary granulations between and below the main (2+2) metatergal crests. In addition, the epiproct in *Monachodesmus* is often fully concealed from above by the medially fused ultimate dorsal crests, although in some species it remains up to fully exposed due to the rather short and independent ultimate crests. All possible transitions in the degree of fusion and caudad protrusion of the ultimate crests are thereby observed.

In general, the ultimate crests (usually 19th, depending on the number of body segments) being very considerably elongated/extended caudad is a common trait among tropical Pyrgodesmidae. There can hardly be any doubt that this condition may have appeared many times in the course of the family's evolution. Putting special emphasis on this character alone has resulted in such speciose artificial assemblages as the genera *Lophodesmus* Pocock, 1892, *Myrmecodesmus* Silvestri, 1910, *Monachodesmus* and some others. Thus, *Lophodesmus* is actually based on *L. pusillus* Pocock, 1894, a species from Flores, Indonesia, but numerous congeners have since been described not only from tropical parts of Asia, but also from Africa and, especially, America. Hoffman [1999] emphasized that no-one must take *Lophodesmus* seriously at the present. The situation concerning *Myrmecodesmus* seems to be slightly better, as the genus is restricted to the Americas [Hoffman, 1999], whereas *Monachodesmus* remains largely Afrotropical, albeit a species from the Philippines has also been included therein [e.g. Attems, 1940].

We suggest treating all Afrotropical species formally described in or assigned to *Lophodesmus* as actually belonging to *Monachodesmus*. Among the African *Lophodesmus*, only *L. cristulifera* Brolemann, 1920, from Zanzibar, and *L. escherichii* Silvestri, 1911, from Eritrea, show small intercalary granulations and/or caudal lobulations between the main crests [Silvestri, 1911; Brolemann, 1920]. Both these species are newly transferred to *Monachodesmus*, comb.n. One of the new species of *Monachodesmus* described below also has intercalary granulations and caudal lobulations, but nei-

ther caudo- nor anterolaterals are observed on the paraterga in *Monachodesmus* species. *Urodesmus sexcarinatus* Porat, 1894, which has been transferred to *Lophodesmus* since Attems [1940], likewise seems to be a species of *Monachodesmus*, comb.n. As regards the status of *Stegodesmus leonis* Cook, 1896, from Sierra Leone, its description is too concise to properly allocate that species in a genus [Cook, 1896]. Attems [1940] listed it among unidentifiable *Lophodesmus* spp.

The following species are attributed to *Monachodesmus*: *M. feae* Silvestri, 1927, the type species from Principe Island, São Tome & Principe, *M. escherichii* (Silvestri, 1911), comb.n. ex *Lophodesmus*, from Eritrea, *M. cristulifera* (Brolemann, 1920), comb.n. ex *Lophodesmus*, from Zanzibar, *M. conquisitus* (Silvestri, 1927), from Ghana, *M. angustus* (Silvestri, 1917) and *M. tardus* (Silvestri, 1917), both from Nigeria, *M. subangustus* (Silvestri, 1927), comb.n. ex *Lophodesmus*, from Guinea-Bissau, *M. lentus* Silvestri, 1927, and *M. spurcus* Silvestri, 1927, both from Cameroon, *M. artatus* Mauriès et Maurin, 1981, *M. abijiensis* Mauriès et Maurin, 1981, and *M. unus* Mauriès et Maurin, 1981, all three from Côte d'Ivoire, *M. odiosus* Demange et Mauriès, 1975, from Côte d'Ivoire and Guinea, *M. silvestrii* Mauriès, 1968, from Gaboon, as well as *M. lundanus* (Chamberlin, 1951), and *M. albus* Kraus, 1958, both from Angola [Silvestri, 1917, 1927; Chamberli, 1951; Kraus, 1958; Mauriès, 1968; Demange, Mauriès, 1975; Mauriès, Maurin, 1981]. Emphasizing the similarities in gonopod structure alone, Mauriès & Maurin [1981] accepted the subgenus *Monachodesmus* s.str. to encompass *M. feae*, *M. angustus*, *M. albus* and probably also *M. lentus*, as opposed to the subgenus *Lophoporus* Attems, 1931, which those authors revived. Attems [1931] had erected, but quickly abandoned it altogether [Attems, 1940]. According to Mauriès & Maurin [1981], *Lophoporus* contains the following species: *M. tardus* (the type species of the subgenus), *M. spurcus*, *M. conquisitus*, *M. silvestrii*, *M. odiosus*, *M. artatus*, *M. abijiensis* and *M. unus*, which all share a long slender branch on the gonopod femorite. Indeed, it seems that only the gonopod conformation rather than peripheral, somatic characters can provide real clues for formally splitting the genus into natural species groups. This is a difficult task though, because the gonopods are mostly complex, homologies of certain parts too often being not so easy to trace.

Below we add another two new congeners.

Species descriptions

Urodesmus cornutus **sp.n.**

Figs 1A, 2, 3.

HOLOTYPE ♂ (MRAC 22656), Cameroon, Campus Université Yaoundé 1, N 03°53', E 011°30', 860 m a.s.l., 17.III.2014, leg. A. Nzoko.

PARATYPES: 2 ♂♂, 1 ♀, 2 juv. (MRAC 22657), 1 ♂, 1 ♀ (MARC 22662), 3 ♂♂, 1 ♀, 11 juv. (UYC), 1 ♂, 1 ♀, 1 juv. (ZMUM ρ2664), same data, together with holotype; 1 ♂, 2 ♀♀, 1 juv. (UYC), same locality, 14.III.2014; 1 ♂, 2 ♀♀ (UYC), same locality, 28.IV.2014; 2 ♂♂, 3 ♀♀, 11 juv. (MRAC 22660), same locality, 23.IV.2014; 1 ♀ (UYC), same locality, 4.VI.2014; same locality, 1 ♂, 6 ♀♀ (MRAC 22658), same locality, 6.X.2014; 2 ♀♀, 25 juv. (MRAC 22659), same locality, 28.V.2015, all leg. A. Nzoko.

NON-TYPES: 1 ♀ (MRAC 22665), Cameroon, Zamakoué, N 03°33′, E 011°31′, ca 2320 m a.s.l., 11.IV.2015; 1 ♂ (MRAC 22666), same locality, 28.IV.2014; 2 ♀♀ (MRAC 22664), Cameroon, Ongot, N 03°51′, E 011°25′, ca 810 m a.s.l., 19.X.2014; 1 ♀ (MRAC 22666), same locality, 18.IV.2014; 1 ♀ (MRAC 22663), same locality, 19.X.2014; 1 juv. (UYC), same locality, 7.II.2015; 1 ♀ (UYC), same locality, 28.IV.2015; 1 juv. fragment (UYC), Cameroon, Egoutadjap, N 02°42′, E 011°03′07, ca 2020 m a.s.l., 11.IV.2015; 1 juv. (MRAC 22661), same locality, 19.VII.2014, all leg. A. Nzoko.

NAME. To emphasize the collum bearing two strong, forward directed, paramedian protuberances which clearly overhang the collum's anterior margin and give the animal a highly characteristic, cornuted appearance; adjective.

DIAGNOSIS. Differs mostly by ♂ prefemur 4 showing a conspicuous distoventral trichostele, the tip of the epiproct being fully concealed from above by paraterga 19, as well as in mesal branch **D** of the gonopod telopodite being considerably higher than lateral branch **C**. See also Key below.

DESCRIPTION. Length of adults ca 11–15, width of midbody pro- and metazonae 1.2–1.7 and 2.0–3.2, respectively (♂, ♀). Holotype ca 13 mm long, 1.3 and 3.0 mm wide on pro- and metazonae, respectively. ♂♂ usually slightly smaller than ♀♀. General coloration in alcohol light yellow-olive green, usually with heavily earth-encrusted, reddish to brown margins of paraterga, most if not all dorsal protuberances (MD). Cleaner specimens, usually juveniles, from pallid to yellowish. Antennae, venter and legs yellowish.

Head smooth, roundish, genae square; clypeolabral region very finely and densely setose, epicranial suture visible only in occipital region; interantennal isthmus about twice as large as diameter of antennal socket; vertigial region with two elongated fields of fine microgranulations along epicranial suture (Fig. 2D). Antennae medium-sized, clavate, C-shaped, each lying inside a distinct groove, closely appressed to head, with small compact apicodorsal groups of bacilliform sensilla on antennomeres 5 and 6; the former clearly the longest and largest (Fig. 2D).

Body with 20 segments (♂, ♀). In width, head << collum = segment 2 < 3 < 4 < 5=15; thereafter body gradually tapering towards telson. Body polydesmoid, with very broad, subhorizontal, wing-shaped paraterga set very low (nearly level to venter), usually faintly uptuned laterad (Figs 1A, 2A–I). Collum flabellate, very wide, fully covering the head from above; anterior margin nearly straight, with 5+5 equal and modest lobulations, central region with 1+1 very high, finger-shaped, often vaguely bifid, rounded, inclined more forward than dorsad, thick protuberances; the latter subcontiguous basally, about as wide as midbody paraterga, both clearly overhanging collum's anterior margin; neither intercalary granulations nor (caudo)lateral lobulations (Figs 1A, 2A, D, H). Parater-

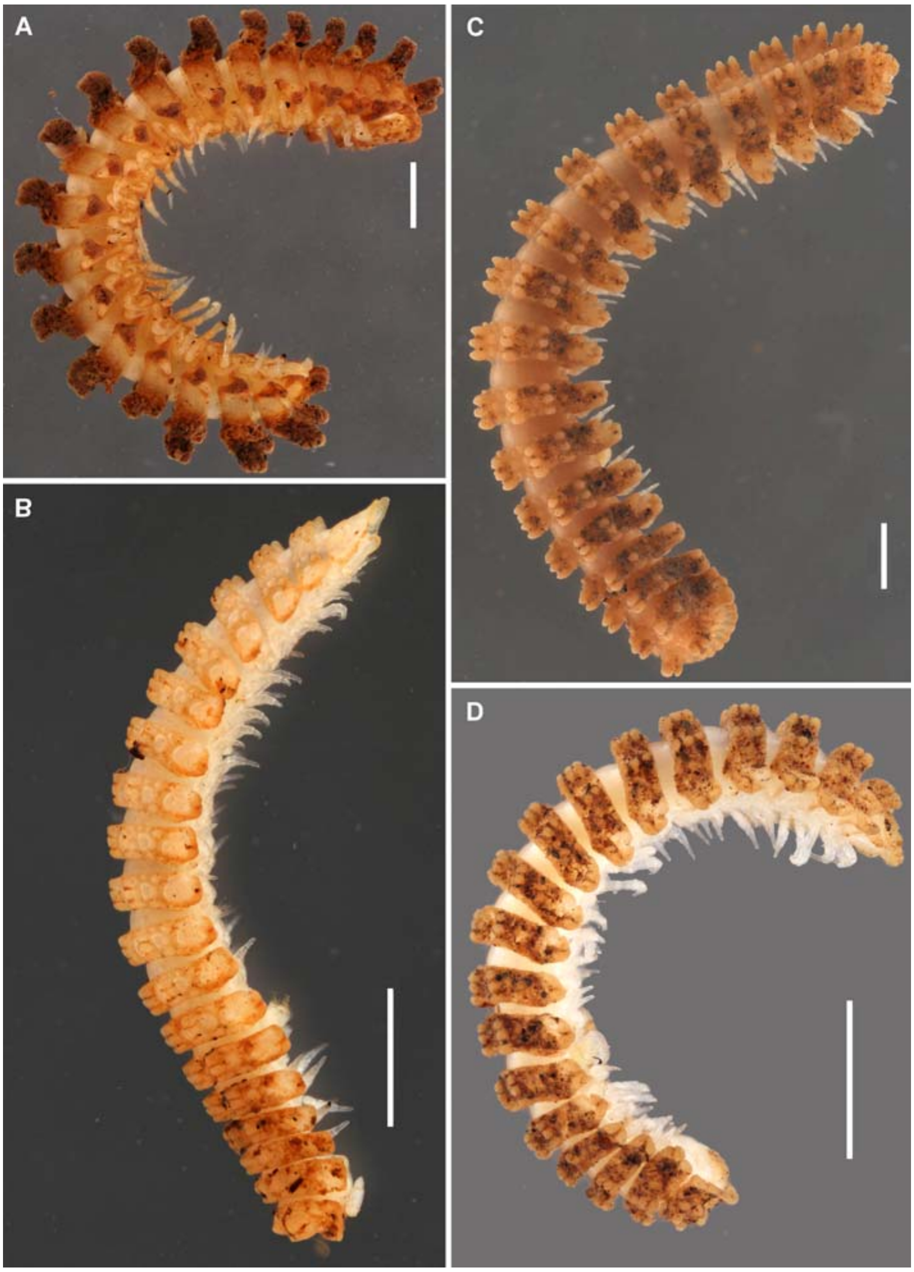


Fig. 1. Habituses of *Urodesmus cornutus* sp.n. (A), *Monachodesmus longicaudatus* sp.n. (B), *M. armorum* sp.n. (C) and *Udodesmus camerunensis* sp.n. (D), ♂ paratype, ♂ paratype, ♂ holotype and ♂ holotype, lateral views, respectively. Scale bars: 1.0 mm.

Рис. 1. Внешний вид *Urodesmus cornutus* sp.n. (A), *Monachodesmus longicaudatus* sp.n. (B), *M. armorum* sp.n. (C) и *Udodesmus camerunensis* sp.n. (D), соответственно паратип ♂, паратип ♂, голотип ♂ и голотип ♂, сбоку. Масштаб: 1,0 мм.

ga 2 slightly enlarged, lateral margin vaguely trilobate, sides strongly declivous to subvertical; dorsal protuberances (MD) on postcollum metaterga similarly high, clearly separated, sigmoid in lateral view, mostly subvertical; starting with paraterga 3, lateral margin vaguely bilobate, mostly subrectangular at anterior and posterior corners; neither intercalary granulations nor caudolateral, nor anterolateral lobulations, nor tergal setae (Figs 1A, 2A–I). Metaterga strongly convex (Fig. 2G), with a usual cerategument layer on top of microvilli; middle parts sometimes also encrusted with earth material, with neither bosses nor areations. Pore formula normal: 5, 7, 9, 10, 12, 13, 15–19; very evident, coniform, simple porosteles present only in paraterga 5, 7, 9, 10, 12, 13, 15 and 16, in segments 17–19 opening flush on tergal surface, always lying on caudal lobulation near caudal corner (Fig. 2A–J). MD growing increasingly inclined caudad on segments 17–19, penultimate protuberances overhanging and reaching tips of ultimate ones (Figs 1A, 2C, F, I). Limbus very finely crenulate-denticulate (Fig. 2K). Epiproct completely, but rather little concealed from above between ultimate

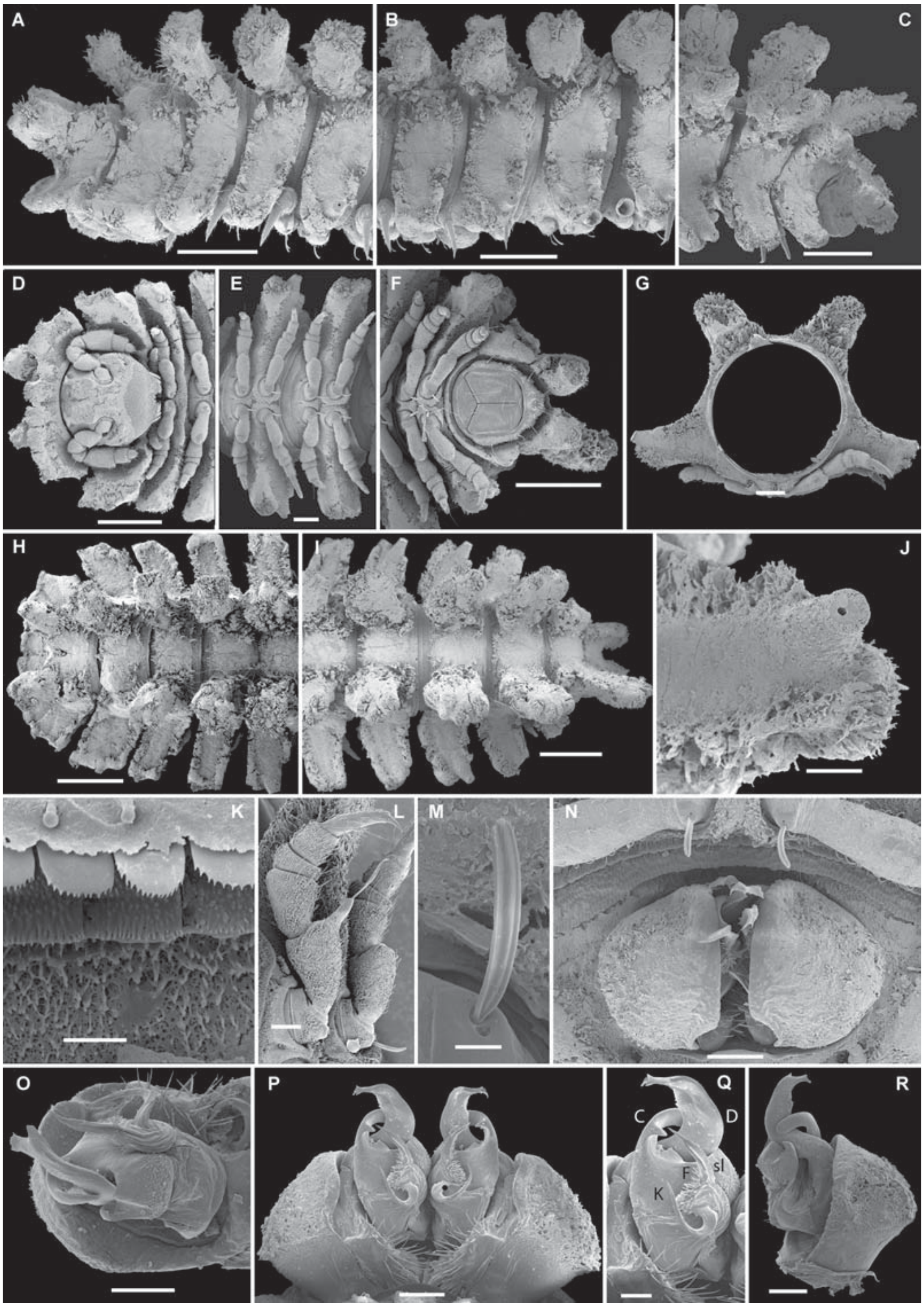


Fig. 2. SEM micrographs of *Urodesmus cornutus* sp.n., ♂ paratype. A, D & H — anterior part of body, lateral, ventral and dorsal views, respectively; B & E — midbody segments, lateral and ventral views, respectively; C, F & I — posterior part of body, lateral, ventral and dorsal views, respectively; G — cross-section of a midbody segment, caudal view; J — poriferrous paratergite with porostele, dorsal view; K — limbus and adjacent microstructures; L — legs 4 & 5, ventral view; M — seta on coxa 2, ventral view; N & P — both gonopods in situ, ventral and caudal views, respectively; O — left gonopod, mesal view; Q & R — right gonopod, caudal and sublateral views, respectively. Scale bars: 0.5 (A–D, F, H, I), 0.2 (E), 0.1 (J, L, N), 0.02 (M) & 0.01 mm (K). Designations in text.

Рис. 2. Фотографии SEM *Urodesmus cornutus* sp.n., паратип ♂. A, D, H — передняя часть тела, соответственно сбоку, снизу и сверху; B, E — среднетуловищные сегменты, соответственно сбоку и снизу; C, F, I — задняя часть тела, соответственно сбоку, снизу и сверху; G — поперечный срез среднетуловищного сегмента, сзади; J — несущий пору паратергит с поростелем, сверху; K — лимбус и смежные микроструктуры; L — ноги 4 и 5, снизу; M — щетинка на тазике 2, снизу; N, P — оба гонопода на месте, соотваетственно снизу и сзади; O — левый гонопод, изнутри; Q, R — правый гонопод, соответственно сзади и почти сбоку. Масштаб: 0,5 (A–D, F, H, I), 0,2 (E), 0,1 (J, L, N), 0,02 (M) и 0,01 мм (K). Обозначения в тексте.

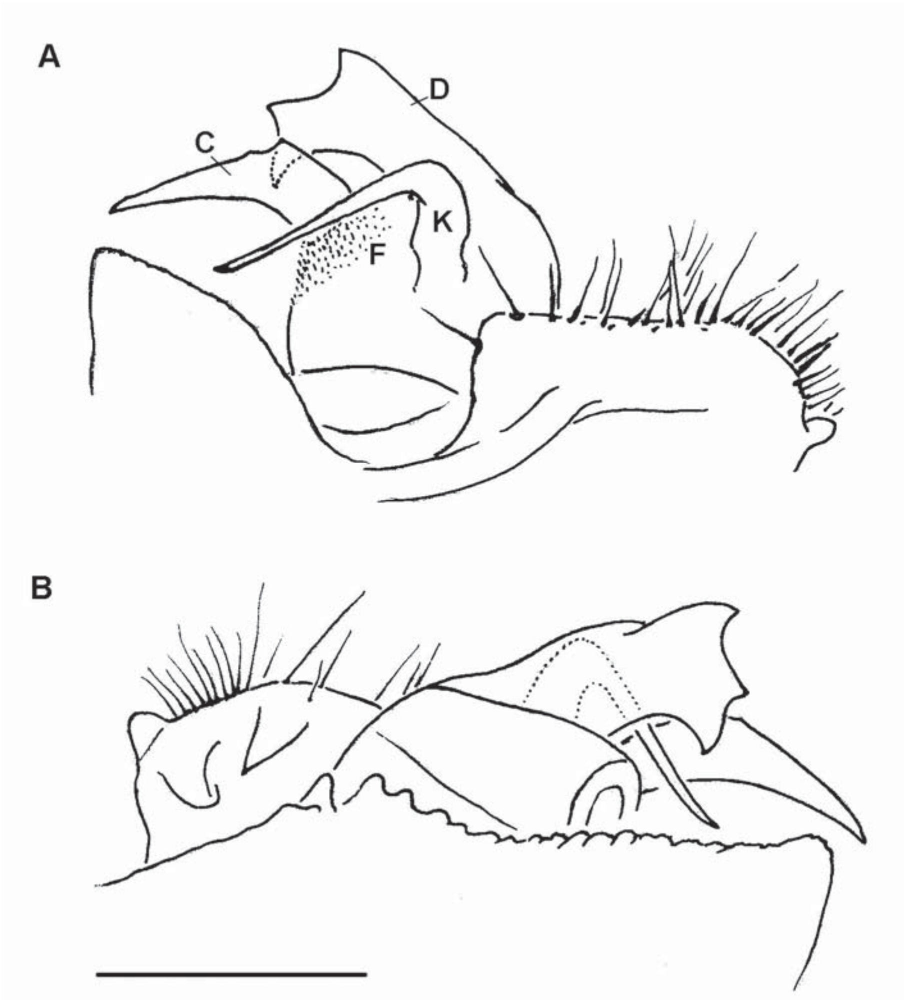


Fig. 3. Left gonopod of *Urodesmus cornutus* sp.n., ♂ paratype. A & B, mesal and lateral views, respectively. Scale bar: 0.1 mm. Designations in text.

Рис. 3. Левый гоновод *Urodesmus cornutus* sp.n., паратип ♂. A, B, соответственно изнутри и сбоку. Масштаб: 0,1 мм. Обозначения в тексте.

protuberances (Fig. 2C, F, I). Hypoproct subtriangular, with 1+1 caudal setae devoid of knobs (Fig. 2F).

Sterna narrow, deeply impressed along axis, without modifications, sparsely setose (Fig. 2E, F). Epigynal ridge behind ♀ coxae 2 very low, rounded on sides. Legs relatively short and stout, not extending beyond lateral edges of paraterga, only tarsi particularly slender; ♂ prefemur 4 with a prominent distoventral trichostele (Fig. 2L); larger setae on ♂ coxae modified, ribbed (Fig. 2M, N). Gonapophyses on ♂ coxae 2 vestigial (Fig. 2D).

Gonopod aperture subcordiform, broad, nearly as wide as prozona 7 (Fig. 2N). Gonopods (Figs 2N–R, 3) rather simple; coxae subglobose, large, microgranulate and micropilose laterally, with usual long cannulae and a rather deep gonocoel; each telopodite deeply bipartite, on caudal face with a characteristically curved pseudoflagelloid process (**K**) at base of a microfimbriate/micropilose field and a lacinia (**F**) marking the end part of a solenomere (**sl**); lateral branch (**C**) sublaciniate, acuminate, subtending on lateral side only a slightly longer, but more massive, tridentate mesal branch (**D**).

REMARKS. Using the various gonopod elements as designated by Silvestri [1927] for *U. erinaceus*, all of its main structures can easily be distinguished: a conspicuous pseudoflagelloid process (**K**) situated on the caudal face at the base of a solenomere (**sl**) which is laciniate and fimbriate. Both main branches of the telopodites which only slightly extend beyond the gonocoel are intricately interlocked, the lateral branch (**C**) subtending the larger mesal branch (**D**).

The following key can serve to separate all four currently known *Urodesmus* species:

1(2) 1+1 dorsal protuberances on collum nearly fully fused, dorsal protuberances (MD) on segment 18 far less strongly inclined caudad, leaving those on 19th, as well as telson fully exposed in dorsal view. .... *U. camerunensis*

2(1) 1+1 dorsal protuberances on collum fully separated, these on segment 18 far more strongly inclined caudad, in dorsal view covering much or all of those on 19th, sometimes entire telson as well. 3

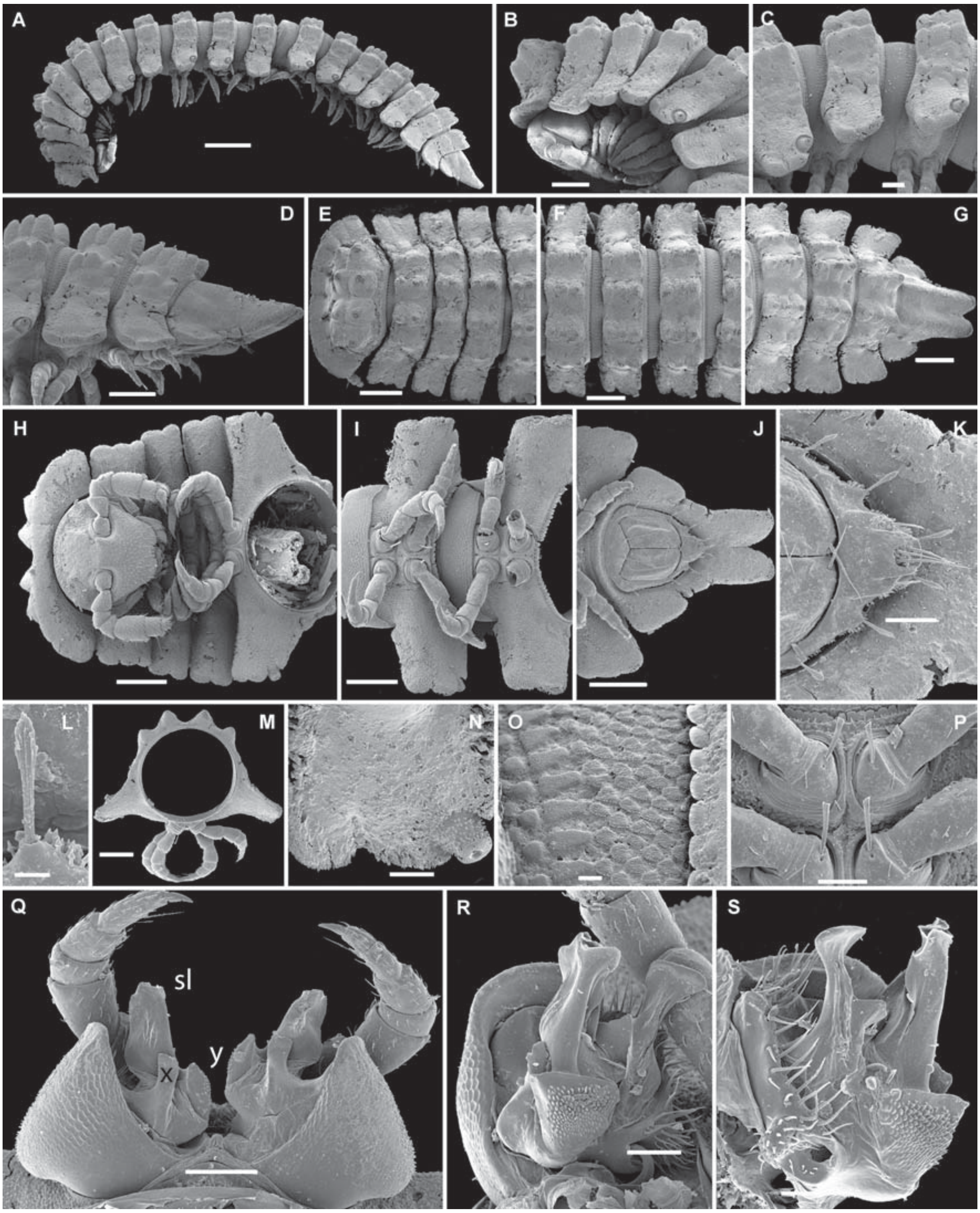


Fig. 4. SEM micrographs of *Monachodesmus longicaudatus* sp.n., ♂ paratype. A — habitus, lateral view; B, E & H — anterior part of body, lateral, dorsal and ventral views, respectively; C, F & I — midbody segments, lateral, dorsal and ventral views, respectively; D, G & J — posterior part of body, lateral, dorsal and ventral views, respectively; K — epiproct, ventral view; L — distoventral coxal seta, ventral view; M — cross-section of a midbody segment, caudal view; N — poriferrous paratergite with porostele, dorsal view; O — limbus and adjacent microstructures; P — midbody sterna and coxae with setae, ventral view; Q — both gonopods in situ and legs 7, caudal view; R — right gonopod, ventrocaudal view; S — left gonopod, mesal view. Scale bars: 0.5 (A), 0.2 (B, D–J, M), 0.1 (C, O–S), 0.05 (K, N), 0.02 (M), & 0.01 mm (L). Designations in text.

Рис. 4. Фотографии SEM *Monachodesmus longicaudatus* sp.n., паратип ♂. A — общий вид, сбоку; B, E, H — передняя часть тела, соответственно сбоку, сверху и снизу; C, F, I — среднетуловищные сегменты, соответственно сбоку, сверху и снизу; D, G, J — задняя часть тела, соответственно сбоку, сверху и снизу; K — эпипрокт, снизу; L — дистовентральная щетинка на тазике, снизу; M — поперечный срез среднетуловищного сегмента, сзади; N — несущий пору паратергит с поростелем, сверху; O — лимбус и смежные микроструктуры; P — среднетуловищные стерниты и тазики со щетинками, Q — оба гонопода на месте и ноги 7, сзади; R — правый гонопод, одновременно снизу и сзади; S — левый гонопод, изнутри. Масштаб: 0,5 (A), 0,2 (B, D–J, M), 0,1 (C, O–S), 0,05 (K, N), 0,02 (M) и 0,01 мм (L). Обозначения в тексте.

3(4) Tips of 1+1 dorsal protuberances on collum single, not subdivided even vaguely. MD on segment 19 especially strongly inclined caudad, clearly overreaching tips of paraterga 19. .... *U. simplex*
4(3) Tips of 1+1 dorsal protuberances on collum, often however vaguely, subdivided into two or four. MD on segment 19 at most reaching tips of paraterga 19. 5
5(6) ♂ prefemur 4 with a conspicuous distoventral trichostele (Fig. 2L). Tip of epiproct fully concealed from above by paraterga 19 (Fig. 2F, I). Mesal branch **D** of gonopod telopodite considerably higher than lateral branch **C** (Figs 2P–R, 3). .... *Urodesmus cornutus* sp.n.
6(5) ♂ prefemur 4 unmodified. Tip of epiproct fully exposed from above between paraterga 19. Mesal branch **D** of gonopod telopodite usually about as high as lateral branch **C**. If branch **D** clearly longer than **C**, then dorsal protuberances and paraterga considerably smaller, each only about as broad as high (*U. e.* var. *minor*). .... *Urodesmus erinaceus*

Monachodesmus longicaudatus **sp.n.**
Figs 1B, 4, 5.

HOLOTYPE ♂ (MRAC 22667), Cameroon, Campus Université Yaoundé 1, N 03°53′, E 011°30′, 860 m a.s.l., 8.III.2014, leg. A. Nzoko.

PARATYPES: 1 ♂, 1 ♀ (MRAC 22670), same locality, 7.VII. 2014; 1 ♂ fragment, 1 ♀ (MRAC 22673), 2 ♂♂, 1 ♀, 1 frament (UYC), same locality, 28.V.2014; 1 ♂, 1 ♀ (ZMUM ρ2666), same locality, 24.IV.2014; 1 ♀ subadult (MRAC 22672), same locality, 12.IV.2014; 2 ♀♀, 6 juv. (MRAC 22671), same locality, 6.X.2014; 1 ♀ fragment (without caudal part of body) (MRAC 22668), same locality, 28.V.2014, all leg. A. Nzoko.

NON-TYPES: 1 fragment (posterior part of body) (UYC), same locality, 17.III.2014; 1 ♀, 2 subadults (MRAC 22669), Cameroon, Ongot, N 03°51′, E 011°25′, ca 810 m a.s.l., 19.VII.2014, all leg. A. Nzoko.

NAME. To emphasize the unusually long and caudally extended paraterga 19; adjective.

DIAGNOSIS. Differs mostly in the tip of the epiproct being fully concealed from above by the extremely long and medially fused dorsal crests (MD) on segment 19, coupled with the gonopod telopodite being deeply bipartite, divided into a shorter, caudal, simple, spade-shaped process (**x**) and a higher, similarly simple, plate-like, anterolateral solenomere (**sl**). See also Key below.

DESCRIPTION. Length of adults ca 6–8, width of midbody pro- and metazonae 0.6–0.8 and 1.2–1.3 mm, respectively (♂, ♀). Holotype ca 6 mm long, 0.7 and 1.2 mm wide on pro- and metazonae, respectively. ♂♂ usually slightly smaller than ♀♀. General coloration in alcohol light beige, usually with earth-encrusted, reddish to brown margins of paraterga and sometimes also dorsal crests (Fig. 1B). Cleaner specimens, usually juveniles, from pallid to yellowish. Vertigial paramedian regions above antennae usually yellowish.

Head smooth, roundish, genae square; clypeolabral region very finely and densely setose, epicranial suture visible only in occipital region; interantennal isthmus about twice as large as diameter of antennal socket; vertigial region with two elongated fields of fine microgranulations along epicranial suture (Fig. 4H). Antennae medium-sized, clavate, C-shaped, each lying inside a distinct groove, closely appressed to head, with small compact apicodorsal groups of bacilliform sensilla on antennomeres 5 and 6; the former clearly the longest and largest (Fig. 2H).

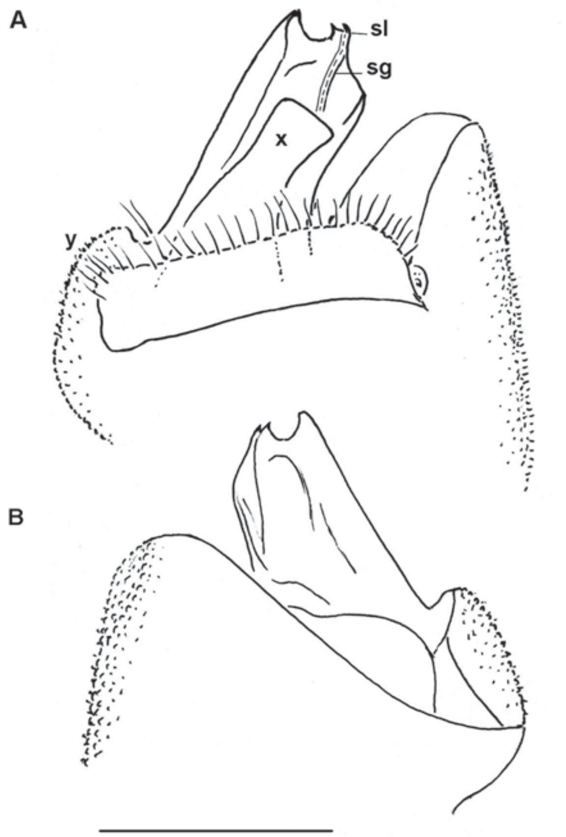


Fig. 5. Left gonopod of *Monachodesmus longicaudatus* sp.n., ♂ paratype. A & B, submesal and sublateral views, respectively. Scale bar: 0.1 mm. Designations in text.

Рис. 5. Левый гонопод *Monachodesmus longicaudatus* sp.n., паратип ♂. A, B, соответственно почти изнутри и почти сбоку. Масштаб: 0,1 мм. Обозначения в тексте.

Body with 20 segments (♂, ♀). In width, head << collum = segment 2 < 3 < 4 < 5=15; thereafter body gradually tapering towards telson. Body polydesmoid, with broad, moderately declivous, wing-shaped paraterga set very low (nearly level to venter) (Figs 1B, 4A–G, M, N). Collum flabellate, very wide, fully covering the head from above; anterior margin nearly straight, with 5+5 equal and faint lobulations, only 2+2 lateralmost lobulations located at a clearly rounded margin; central region with 2+2 high, distinctly bifid, basally subcontiguous crests, these being inclined more forward than dorsad, not overhanging collum's anterior margin; neither intercalary granulations nor (caudo)lateral lobulations (Figs 1B, 4A, B, H). Lateral margin of paraterga 2 trilobate, following ones bilobate; sides strongly declivous to subvertical; MD on postcollum metaterga similarly high, narrow, clearly separated, mostly subvertical, MD only slightly highter than lateral crests (DL), largely rather vaguely trilo-

bate; starting with paraterga 2, lateral margin mostly subrectangular at anterior and posterior corners; neither intercalary granulations nor caudolateral, nor anterolateral lobulations, nor tergal setae (Figs 1B, 4A–I, M, N). Metaterga strongly convex (Fig. 4M), with a usual cerategument layer on top of microvilli (Fig. 4K, N); middle parts sometimes also encrusted with earth material, with neither bosses nor areations. Pore formula normal: 5, 7, 9, 10, 12, 13, 15–19; very evident, coniform, simple porosteles present only in paraterga 5, 6, 8, 9, 11, 12, 14, 15 & 16, in segments 17–19 opening flush on tergal surface, always lying on caudal lobulation near caudal corner (Fig. 4A–G, N). MD growing only slightly inclined caudad on segments 17 and 18, on segment 19 suddenly and greatly extended backwards, fused before tip into a deeply bilobate end which is nearly as long as telson (Figs 1B, 4C, G, I). Limbus very finely crenulate (Fig. 4O). Epiproct completely and very strongly concealed from above between medially fused ultimate crests (Fig. 4C, D, I, K). Hypoproct subtriangular, with 1+1 caudal setae devoid of knobs (Fig. 4I).

Sterna narrow, deeply impressed along axis, without modifications, sparsely setose (Fig. 4H, I, M, P). Epigynal ridge behind ♀ coxae 2 very low, rounded on sides. Legs relatively short and stout, not extending beyond lateral edges of paraterga, only tarsi particularly slender; larger setae on ♂ coxae modified, ribbed (Fig. 4L, P). Gonapophyses on ♂ coxae 2 vestigial.

Gonopod aperture subcordiform, broad, nearly as wide as prozona 7. Gonopods (Figs 4Q–S, 5) rather simple; coxae subglobose, large, microgranulate and micropilose laterally, with usual long cannulae and a rather deep gonocoel; each telopodite deeply bipartite, on caudal face with a shorter, characteristically spade-shaped process (**x**) lying opposite a smaller, rounded, mesal, laterally micropapillate bulge (**y**) and a far larger, but simple, anterolateral, apically faintly microdenticulate, plate-like solenomere (**sl**) supporting a seminal groove (**sg**) on its caudal face.

Monachodesmus armorum sp.n.

Figs 1C, 6, 7.

HOLOTYPE ♂ (MRAC 22675), Cameroon, Ongot, N 03°51′, E 011°25′, open terrane, ca 810 m a.s.l., 19.VII.2014, leg. A. Nzoko.

PARATYPE: 1 ♂ (MRAC 22674), Cameroon, Zamakoué, N 03°33′, E 011°31′, forest, ca 2320 m a.s.l., 19.IV.2014, leg. A. Nzoko.

NON-TYPE: 1 ♀ (MRAC 22676), Cameroon, Campus Université Yaoundé 1, N 03°53′, E 011°30′, 860 m a.s.l., 28.IV.2014, leg. A. Nzoko.

NAME. To emphasize the unusual, shield-shaped, mesal plate of the gonopod telopodite (**sh**); noun in apposition.

DIAGNOSIS. Differs mostly by the relatively large size, the epiproct being fully exposed from above, as well as in the sheld-like mesal plate (**sh**) of the gonopod telopodite. See also Key below.

DESCRIPTION. Length ca 16–17, width of midbody pro- and metazonae 1.3–1.5 and 2.4–2.5 mm, respectively (♂, ♀). Holotype ca 17 mm long, 1.3 and 2.5 mm wide on pro- and metazonae, respectively. General coloration in alcohol light beige yellowish to light grey, usually with partly earth-encrusted, brown to grey-brown metaterga and dorsal crests (Fig. 1C). Vertigial paramedian regions above antennae usually yellowish brown.

Body with 20 segments (♂, ♀). Body polydesmoid, with rather narrowly, poorly declivous, wing-shaped paraterga set very low (nearly level to venter) (Figs 1C, 6A–J). Collum flabellate, very wide, fully covering the head from above; anterior margin pooly and regularly arcuate, with 5+5 equal and rather faint lobulations; central region with 1+1 high, basally rather clearly separated crests somewhat divided only subapically, the knob-shaped tips being single (only anteriorly, ♂) or bifid (both anteriorly and posteriorly, ♀); crests inclined more forward than dorsad, not overhanging collum's anterior margin; neither intercalary granulations nor (caudo)lateral lobulations (Figs 1C, 6A, H). Dorsum strongly convex, sides up to subvertical; dorsal crests (MD) on postcollum metaterga only slightly higher than lateral ones (DL), narrow, clearly separated, only on segments 3 and 4 bilobate, on other segments clearly trilobate; nearly not inclined caudad even on segments 17 and 18, much smaller on segment 19; intercalary granulations usually distinct, pattern typical of Pyrgodesmidae, i.e. these being arranged in two rows of 3+3 between main crests and in 2–3 irregular rows of 3+3 on sides below lateral crests; caudal intercalary granulations forming a row of small caudomarginals extending down to bases of paraterga, but leaving entire latter free from caudo- or anterolaterals (Figs 1C, 6A–K). Pores or poroseles lying on caudal lobulation near caudal corner (Fig. 6K). Neither dorsal crests nor paraterga 19 considerably extended backwards, leaving epiproct fully exposed in dorsal view (Figs 1C, 6C, F, J).

Legs short, barely reaching sides of paraterga, crassate, unmodified; gonapophyses vestigial (Fig. 6D–G, L).

Gonopods (Figs 6N, O, 7) rather simple; gonocoel rather deep, yet leaving much telopodite exposed; each telopodite deeply bipartite, lateral branch (**l**) long and slender, subacuminate, strongly exposed beyond gonocoel; mesal branch (**m**) prominent, consisting of a large, ribbed, rounded, shield-like structure (**sh**) on mesal face, a deeply bifid lobe (**l1** and **l2**) on caudal face at base of **sh**, and an abundantly fringed, slender, finger-shaped solenomere (**sl**) lying between **l1** and **sh**.

REMARKS. The following key can serve to separate all 18 currently known *Monachodesmus* species. By necessity, the key is provisional, largely based on somatic chacters, because several species are only known from ♀ material, whereas the gonopod structure is often too complex to easily interpret.

1(2) Smaller intercalary granulations present at least between main crests, caudolaterals present. 3

2(1) Smaller intercalary granulations on metaterga untraceable, caudolaterals absent. 19

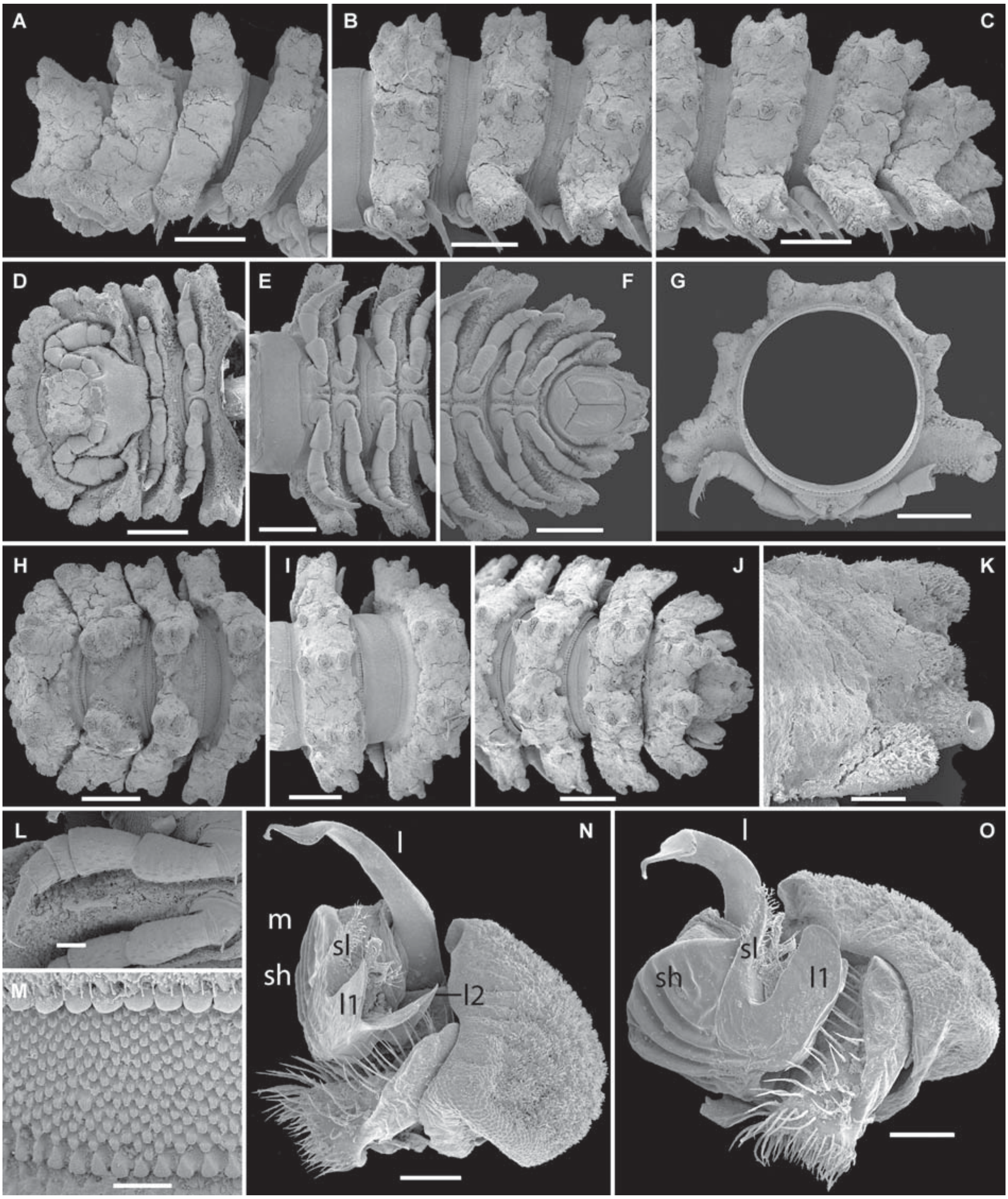


Fig. 6. SEM micrographs of *Monachodesmus armorum* sp.n., ♂ paratype (A–M), ♂ holotype (N & O). A, D & H — anterior part of body, lateral, ventral and dorsal views, respectively; B, E & I — midbody segments, lateral, ventral and dorsal views, respectively; C, F & J — posterior part of body, lateral, ventral and dorsal views, respectively; G — cross-section of a midbody segment, caudal view; K — poriferrous paratergite with porostele, dorsal view; L — midbody leg, ventral view; M — limbus and adjacent microstructures; N & O — left gonopod, caudal and mesal views, respectively (tip broken off). Scale bars: 0.5 (A–J), 0.1 (K. L, N, O) & 0.05 (M). Designations in text.

Рис. 6. Фотографии SEM *Monachodesmus armorum* sp.n., паратип ♂ (A–M), голотип ♂ (N и O). A, D, H — передняя часть тела, соответственно сбоку, снизу и сверху; B, E, I — среднетуловищные сегменты, соответственно сбоку, снизу и сверху; C, F, J — задняя часть тела, соответственно сбоку, снизу и сверху; G — поперечный срез среднетуловищного сегмента, сзади; K — несущий пору паратергит с поростелем, сверху; L — среднетуловищная нога; M — лимбус и смежные микроструктуры; N, O — левый гонопод, соответственно сзади и изнутри (вершина обломана). Масштаб: 0,5 (A–J), 0,1 (K, L, N, O) и 0,05 мм (M). Обозначения в тексте.

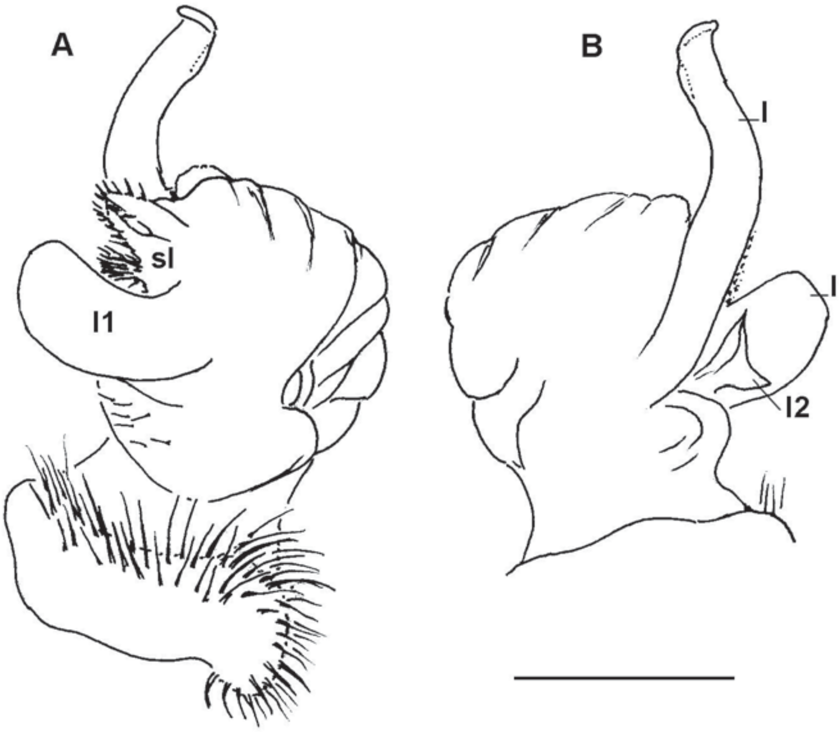


Fig. 7. Right gonopod of *Monachodesmus armorum* sp.n., ♂ paratype. A & B, mesal and lateral views, respectively. Scale bar: 0.2 mm. Designations in text.

Рис. 7. Правый гонопод *Monachodesmus armorum* sp.n., паратип ♂. А и В, соответственно изнутри и сбоку. Масштаб: 0,2 мм. Обозначения в тексте.

3(4) Larger: adults 16–17 mm long. High, 1+1, at most slightly bifid, central tubercles on collum (Fig. 6A, H). Epiproct fully exposed in dorsal view (Figs 1C, 6C, F, J). Cameroon. .... *M. armorum* sp.n.

4(3) Smaller: length < 10 mm. Several small, round tubercles in central part of collum, often including a few caudolaterals. Epiproct at least slightly, but fully concealing the epiproct in dorsal view. 5

5(6) Only postcollum metaterga with intercalary granulations, these being absent from collum. 7

6(5) Collum also with intercalary granulations, traceable at least as caudals and/or caudolaterals. 9

7(8) Collum with 2+2 and 2+2 small, round tubercles arranged centrally in two transverse rows. Caudal tip of medially fused paraterga 19 deeply bilobed, notch nearly reaching the tip of epiproct. Cameroon. . *M. spurcus*

8(7) Collum with 2+2 and 3+3 small, round tubercles arranged centrally in two transverse rows. Caudal tip of medially fused paraterga 19 only rather faintly bilobed, notch far from reaching the tip of epiproct. Ghana. .... *M. conquisitus*

9(10) Collum with 2+2 and 2+2 small, round tubercles arranged centrally in two transverse rows, plus 6+6 smaller caudolaterals. Nigeria. .... *M. angustus*

10(9) Collum's ornamentation different. 11

11(12) Collum with two compact paramedian groups of 2+2 and 2+2 larger, rounded tubercles, plus a row of several smaller, grain-shaped caudals. Cameroon. .... *M. lentus*

12(11) Collum's ornamentation different. 13

13(14) Collum with 2+2 and 3+3 small, round tubercles arranged centrally in two transverse rows, plus at least several small caudals. 15

14(13) Collum's ornamentation different. 17

15(16) Ultimate dorsal crests less strongly elongated caudad, broadly and roundly bilobed, deeply split, not or barely concealing the epiproct from above. Guinea Bissau. .... *M. subangustus*

16(15) Ultimate dorsal crests more strongly elongated caudad, much narrower, lanceolate, subacuminate, very distinctly concealing the epiproct from above. Angola. .... *M. albus*

17(18) Collum with 3+3 and 3+3 small, round tubercles arranged centrally in two transverse rows, plus 6+6 smaller caudals. Eritrea. .... *M. escherichii*

18(17) Collum with 2+2 and 2+2 small, round tubercles arranged centrally in two transverse rows, plus 2+2 smaller caudolaterals. Zanzibar. ………………. *M. cristulifera*

19(20) Porosteles extending caudally only until segment 15, being absent from 16th. Angola. …………. *M. lundanus*

20(19) Porosteles present also on segment 16. 21

21(22) Central tubercles on collum very high (Fig. 4B, E). Dorsal crests on segment 19 fused medially and extremely strongly elongate caudad, nearly as long as telson (Fig. 4D, G, J). Cameroon. .... *M. longicaudatus* sp.n.

22(21) Central tubercles on collum considerably lower. Dorsal crests on segment 19 never so strongly elongate caudad, usually at most half as long as telson. 23

23(24) Collum with 2+2 and 2+2 small, round tubercles arranged centrally in two transverse rows. Epiproct only slightly concealed from above by ultumate dorsal crests. 25

24(23) Collum with 2+2 and 3+3 small, round tubercles arranged centrally in two transverse rows. Epiproct ei-

ther exposed or concealed by ultumate dorsal crests in dorsal aspect 27
25(26) Main dorsal and lateral crests poorly differentiated. Côte d'Ivoire and Guinea. .... *M. odiosus*
26(25) Main dorsal crests considerably higher than lateral ones. Cameroon. .... *M. sexcarinatus*
27(28) Main crests on postcollum metaterga inconspicuous, largely composed of small undifferentiated grains or knobs. 29
28(27) Main crests conspicuous, clearly differentiated. . 31
29(30) Most of paraterga very narrow, subvertical, nearly wanting, only a few posterior ones broader and slightly explanate. Dorsal crests on segment 19 only slightly produced caudad, barely concealing the epiproct from above. Côte d'Ivoire. .... *M. unus*
30(29) Paraterga broad and subhorizontal. Dorsal crests on segment 19 fused medially and very strongly produced caudad, about as long as telson. Principe Island, São Tome & Principe. .... *M. feae*
31(32) Dorsal crests on segment 18 strongly inclined caudad, in dorsal view almost reaching the ends of paraterga 19. Nigeria. .... *M. tardus*
32(31) Dorsal crests on segment 18 only slightly inclined caudad, in dorsal view at most reaching until midlength of paraterga 19. 33
33(34) Dorsal crests on segment 18 inclined caudad to reach until about midlength of paraterga 19, dorsal cones before tip of dorsal crests on segment 19 small, knob-shaped. Gaboon. .... *M. silvestrii*
34(33) Dorsal crests on segment 18 nearly not inclined caudad, dorsal cones before tip of dorsal crests on segment 19 larger, clearly elongate. Côte d'Ivoire. 35
35(36) Ultimate cones before tip of dorsal crests on segment 19 drawn caudad clearly beyond notch dividing the tip. .... *M. abijiensis*
36(35) Ultimate cones before tip of dorsal crests on segment 19 reaching caudally only before notch dividing the tip. .... *M. artatus*

Udodesmus camerunensis **sp.n.**
Figs 1D, 8.

HOLOTYPE ♂ (MRAC 22677), Cameroon, Zamakoué, N 03°33′, E 011°31′, forest, ca 2320 m a.s.l., 28.VII.2014, leg. A. Nzoko.

NAME. To emphasize the terra typica; adjective.

DIAGNOSIS. Differs primarily in the undifferentiated lobulations at the anterior margin of the collum, as well as by the ozopore distribution pattern.

DESCRIPTION. Length ca 6 mm, width of midbody pro- and metazonae 0.8 and 1.2 mm, respectively (♂). General coloration in alcohol grey-brown due to vertigial fields of granulations and, especially; collum and metaterga, most of head, including antennae, as well as prozonae, venter and legs nearly pallid (Fig. 1D).

Head smooth, roundish, genae square; clypeolabral region very finely and densely setose, epicranial suture visible only in occipital region; interantennal isthmus about twice as large as diameter of antennal socket; vertigial region with two elongated fields of fine microgranulations along epicranial suture. Antennae medium-sized, clavate, C-shaped, each lying inside a distinct groove, closely appressed to head, with small compact apicodorsal groups of bacilliform sensilla on antennomeres 5 and 6; the former clearly the longest and largest.

Body with 20 segments (♂). In width, head << collum = segment 2 < 3 < 4 < 5=15; thereafter body gradually tapering towards telson. Body polydesmoid, with rather broad, strongly declivous, wing-shaped paraterga set very low (nearly level to venter) (Figs 1D, E, 8). Collum flabellate, very wide, fully covering the head from above; anterior margin regularly arcuate, with 5+5 equal and rather faint lobulations; central region with 2+2 and 3+3 distinct tubercles arranged in two transverse rows, these in anterior row being somewhat higher than those in posterior one; all tubercles clearly separated; neither intercalary granulations nor (caudo)lateral lobulations (Figs 1D, 8A). Lateral margin of paraterga 2 trilobate, following ones bilobate; sides strongly declivous to subvertical; dorsal crests (MD) on postcollum metaterga growing increasingly high towards 17th, then gradually, but clearly reduced towards 19th; MD bilobate on segments 2–4, thereafter distinctly trilobate, only slightly inclined caudad in segments 17 and 18; lateral crests (DL) always trilobate, always shorter than MD, clearly reduced only in segments 18 and 19 (Figs 1D, 8A–D); starting with paraterga 2, lateral margin mostly subrectangular at anterior and posterior corners; neither clear intercalary granulations nor caudolateral, nor anterolateral lobulations, nor tergal setae. Metaterga strongly convex, with a usual cerategument layer on top of microvilli, usually in part lightly encrusted also with earth material, with neither bosses nor areations. Pore formula normal: 5, 7, 9, 10, 12, 13, 15–19; very evident, coniform, simple porosteles present only in paraterga 5, 7, 9, 10, 12, 13 & 15, in segments 16–19 opening flush on tergal surface, always lying on caudal lobulation near caudal corner (Figs 1D, 8B–D). Limbus very finely crenulate. Epiproct nearly completely concealed from above, only tip seen between medially fused ultimate crests (Figs 1D, 8C, D). Hypoproct subtriangular, with 1+1 caudal setae devoid of knobs.

Sterna narrow, deeply impressed along axis, without modifications, sparsely setose. Legs relatively short and stout, not extending beyond lateral edges of paraterga, only tarsi particularly slender; larger setae on ♂ coxae modified, subplumose and ribbed (Fig. 1D). Gonapophyses on ♂ coxae 2 vestigial.

Gonopod aperture subcordiform, broad, nearly as wide as prozona 7. Gonopods (Fig. 8E) rather simple; coxae subglobose, large, microgranulate laterally, with usual long cannulae and a rather deep gonocoel; telopodites in situ crossing medially, each deeply bipartite, basically consisting of a long, infuscate, curved, simple solenophore (**sph**) extending well beyond gonocoel and a somewhat shorter, also simple, rod-shaped solenomere (**sl**), the latter held perpendicular to **sph** and lying on mesal face.

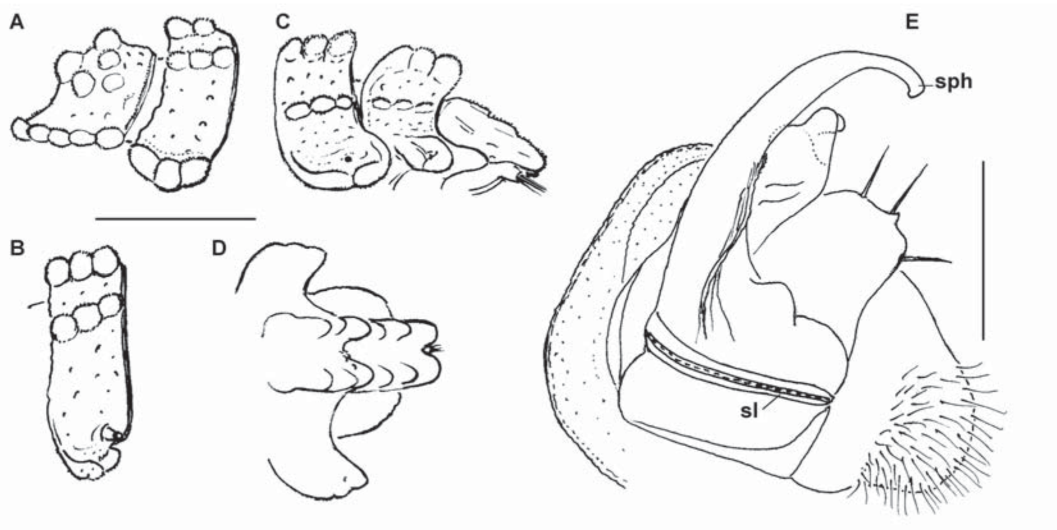


Fig. 8. *Udodesmus camerunensis* sp.n., ♂ holotype. A — collum and segment 2, lateral view: B — segment 10, lateral view; C & D — caudal end of body, dorsal and lateral views, respectively; E — right gonopod, mesal view. Scale bars: 0.5 (A–D) & 0.1 mm (E). Designations in text.

Рис. 8. *Udodesmus camerunensis* sp.n., голотип ♂. А — коллум и сегмент 2, сбоку: В — сегмент 10, сбоку; С, D — задняя часть тела, соответственно сверху и сбоку; Е — правый гонопод, изнутри. Масштаб: 0,5 (A–D) и 0,1 мм (E). Обозначения в тексте.

REMARKS. The West African genus *Udodesmus* Cook, 1896, has recently been reviewed and shown to comprise nine species, all keyed [Golovatch, VandenSpiegel, 2014]. One of the main diagnostic features of *Udodesmus* is the presence of clearly differentiated lobulations at the anterior margin of the collum. The new, and first, *Udodesmus* found in Cameroon is unique in showing these 5+5 lobulations undifferentiated. However, the gonopod conformation which includes the long, strongly exposed, mesally crossing, rather simple solenophores often held perpendicular to similarly long and simple solenomeres leaves no doubt concerning the generic attribution.

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